RCA PF020103 Ref AC cited document

[redacted]D BY APPLICANT [redacted]

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 862 261 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
02.09.1998 Bulletin 1998/36

(51) Int. Cl.[6]: **H02M 3/155**

(21) Application number: **98102933.3**

(22) Date of filing: **19.02.1998**

(84) Designated Contracting States:
AT BE CH DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **27.02.1997 JP 43822/97**

(71) Applicant:
KABUSHIKI KAISHA TOSHIBA
Kawasaki-shi (JP)

(72) Inventors:
- **Noguchi, Minoru**
  1-1 Shibaura 1-chome Minato-ku Tokyo 105 (JP)
- **Katsumi, Takahiro**
  1-1 Shibaura 1-chome Minato-ku Tokyo 105 (JP)
- **Suzuki, Toshiyuki**
  1-1 Shibaura 1-chome Minato-ku Tokyo 105 (JP)
- **Kawagishi, Toshiyuki**
  1-1 Shibaura 1-chome Minato-ku Tokyo 105 (JP)

(74) Representative:
Blumbach, Kramer & Partner GbR
Radeckestrasse 43
81245 München (DE)

(54) Overcurrent protection circuit and method

(57) In an overcurrent protection circuit, when a control section (7) turns on a switch (3) in response to a signal from a microcomputer (5) so that power is supplied from a power source (1) to an IC card (4), a signal controlling section (6) prevents the overcurrent protection circuit from functioning even if a current greater than a predetermined level is detected by a current detecting section (2), until a voltage of the IC card is stabilized. When the control section (7) turns off the switch (3) in response to a signal from the microcomputer (5), power supply from the power source (1) to the IC card (4) is stopped, thereby preventing a malfunction of the overcurrent protection circuit, even if the microcomputer (5) goes out of control or malfunctions.

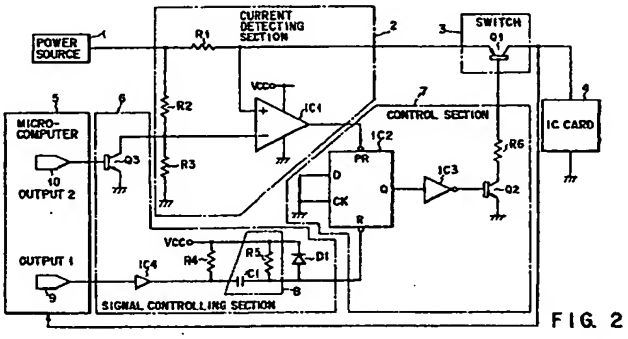

FIG. 2

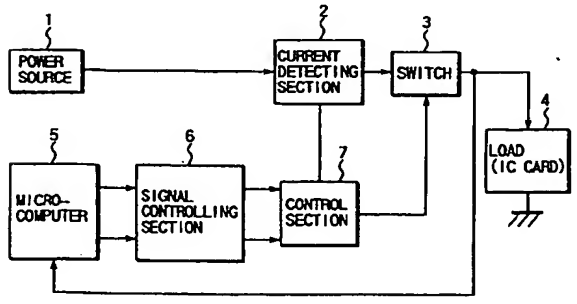

FIG. 1

EP 0 862 261 A2

Description

The present invention relates to an overcurrent protection circuit and an overcurrent protection method for protecting an electric or electronic device, such as an IC (Integrated Circuit) incorporated in an IC card, from an overcurrent due to abnormality in the circuits of the device.

An electric or electronic device, such as an IC card, incorporates an overcurrent protection circuit for protecting the device from overcurrent due to abnormality in the circuits of the device.

Conventionally, a type of overcurrent protection circuit in an electric or electronic device is formed of a combination of a microcomputer and a logical circuit for controlling operations of the circuits in the device. Such an overcurrent protection circuit having a microcomputer and a logical circuit may malfunction when the microcomputer goes out of control or malfunctions or power is supplied thereto.

An object of the present invention is to provide an overcurrent protection circuit and an overcurrent protection method, which prevent the circuit from malfunctioning when the microcomputer goes out of control or power is supplied to the circuit.

According to a first aspect of the invention, there is provided a power supply device for supplying power to an electronic device acting as a load, comprising: power source means for providing power to be supplied to the electronic device; overcurrent protecting means for stopping power supply to the electronic device, when a current supplied to the electronic device is greater than a predetermined current; and stopping means for stopping an operation of the overcurrent protecting means until a load voltage of the electronic device is stabilized, when power is first supplied to the electronic device.

According to a second aspect of the invention, there is provided an overcurrent protection circuit incorporated in a power supply device for supplying power to an electronic device acting as a load, the overcurrent protection circuit comprising: a power source circuit for providing power to be supplied to the electronic device; a controlling circuit for controlling supply and stop of the power provided by the power source circuit to be supplied to the electronic device; detecting circuit for detecting the current supplied to the electronic device, and outputting a signal for stopping the supply of the power to the electronic device by means of the controlling circuit, when a current greater than the predetermined current is detected; and a stopping circuit for stopping a detecting operation of the detecting circuit until a load voltage of the electronic device is stabilized, when power is first supplied to the electronic device.

According to a third aspect of the invention, there is provided an overcurrent protection circuit comprising: power supply means for supplying power; switch means for switching power supply and stop of power supply to an IC card connected to the power supply means; current detecting means for detecting whether a current exceeds a predetermined detection level, when power is supplied from the power supply means to the IC card; stop means for stopping the power supply by switching the switch means, when the current detection means detect that the current exceeds the predetermined detection level; a microcomputer for outputting an instruction signal for switching the switch means; first control means for controlling the predetermined detection level of the current detection means to be a lower detection level until a load voltage of the IC card is stabilized, when power is supplied from the power supply means to the IC card by switching the switch means in accordance with an instruction signal output from the microcomputer; and second control means for performing control of preventing a malfunction due to a false signal output from the microcomputer, when power supply from the power supply means to the IC card is stopped by switching the switch means in accordance with an instruction signal output from the microcomputer.

According to a fourth aspect of the invention, there is provided a method for controlling an overcurrent protection circuit incorporated in a power supply device for supplying power to an electronic device acting as a load, wherein a current supplied to the electronic device is detected by a detecting circuit and power supply to the electronic device is stopped, when the detected current is greater than a predetermined current, the method comprising the steps of: stopping an operation of the detecting circuit until a load voltage of the electronic device is stabilized, when power is first supplied to the electronic device; and releasing the stop of the operation of the detecting circuit after the load voltage of the electronic device is stabilized.

According to a fifth aspect of the invention, there is provided a method for controlling an overcurrent protection circuit including: switch means for switching power supply and stop of power supply to an IC card connected to power supply means for supplying power; a microcomputer for outputting an instruction signal for switching the switch means; and current detecting means for detecting whether a current exceeds a predetermined detection level, when power is supplied from the power supply means to the IC card, the method comprising the steps of: lowering the predetermined detection level of the current detection means to be a lower detection level, when power is supplied from the power supply means to the IC card by switching the switch means in accordance with an instruction signal output from the microcomputer; and raising the lower detection level of the current detection means to be the predetermined detection level in accordance with an instruction signal output from the microcomputer, when the load voltage of the IC card supplied with the power is stabilized.

This invention can be more fully understood from the following detailed description when taken in con-

junction with the accompanying drawings, in which:

FIG. 1 is a block diagram showing a schematic structure of an overcurrent protection circuit according to the present invention;
FIG. 2 is a circuit diagram of the overcurrent protection circuit of the present invention; and
FIG. 3 is a diagram for explaining true values of the flip-flop circuit shown in FIG. 2.

An embodiment of the present invention will be described with reference to the accompanying drawings.

FIG. 1 shows a schematic structure of an overcurrent protection circuit according to the present invention. The overcurrent protection circuit comprises a power source 1 serving as power supplying means, a current detecting section 2 serving as current detecting means, a switch 3 serving as switching means, a load 4 such as an electric or electronic device, a microcomputer 5, a signal controlling section 6 and a control section 7.

The load 4 is, for example, an IC incorporated in an IC card. Power is supplied to the IC card connected to the circuit of the present invention provided in an IC card reader/writer. In the following description, the load is referred to as the IC card 4.

The control section 7 turns on the switch 3 in response to a signal supplied from the microcomputer 5, so that power can be supplied to the IC card 4. After the power is supplied, the current detecting section 2 detects a current flowing through the IC card 4. The control section 7 determines whether the amount of the current is greater or smaller than a preset current, and controls ON/OFF of the switch 3.

The signal controlling section 6 operates so that the control section 7 may not be influenced, even if the microcomputer outputs an abnormal signal, when it goes out of control or malfunctions.

FIG. 2 shows a structure of the overcurrent protection circuit. The overcurrent protection circuit has the elements described above with reference to FIG. 1. The current detecting section 2 comprises a current detecting resistor R1, reference voltage resistors R2 and R3, and a voltage comparator IC1. The switch 3 comprises a power cutoff transistor Q1. The computer 5 outputs an output 1 through a terminal 9 and an output 2 through a terminal 10.

The signal controlling section 6 comprises a transistor Q3, a power limiting resistor R4, a differential circuit 8 having a resistor R5 and a capacitor C1, an overvoltage protecting diode D1, and a buffer IC4. The control section 7 comprises a transistor Q2, a flip-flop circuit IC2, an inverter IC3 and an adjusting resistor R6. The power limiting resistor R4 limits a charge current supplied to the capacitor C1, when a low pulse of the output 1 from the terminal 9 rises in the microcomputer 5. The overvoltage protecting diode D1 prevents an overvoltage of a terminal R of the flip-flop circuit IC2, when the capacitor C1 is charged.

An operation of the overcurrent protection circuit shown in FIG. 2 will now be described.

First, the microcomputer 5 causes the output 2 from the terminal 10 to be high (Hi). As a result, the base terminal of the transistor Q3 becomes high in level, so that the transistor Q3 is turned on. In the voltage comparator IC1, the negative terminal becomes low (Lo) in level, since the transistor Q3 is on, and the level of the output voltage is high. Since the output voltage of the voltage comparator IC1 is high, a terminal PR of the flip-flop circuit IC2 is high in level. Further, the microcomputer 5 causes the output 1 from the terminal 9 to be low, causing a terminal R of the flip-flop IC2 to be low via the buffer IC4.

In the flip-flop circuit IC2, since the terminal PR is high in level and the terminal R is low in level, the terminal Q is low. The inverter IC3 inverts a low signal output from the terminal Q to a high signal, which is input to the base terminal of the transistor Q2. As a result, the transistor Q2 is turned on.

When the transistor Q2 is on, the transistor Q1 is also on, so that power is supplied from the power source 1 to the IC card 4.

In this embodiment, the microcomputer 5 causes the negative terminal of the voltage comparator IC1 to be low in level, while it is keeping the output 2 from the terminal 10 at the high level. Therefore, the current detecting section 2 does not work until the capacitor (not shown) of the IC card 4 is charged. Thus, the overcurrent protection circuit is prevented from malfunctioning.

After the voltage of the IC card 4 is stabilized, the microcomputer 5 causes the output 2 from the terminal 10 to be low in level, so that a voltage is applied to the negative terminal of the voltage comparator IC1 through the reference voltage resistors R2 and R3. In the voltage comparator IC1 for comparing voltages, the voltage at the positive terminal is varied by a voltage drop due to a current flowing through the current detecting resistor R1.

If the IC card 4 disorders, when the current flowing through the current detecting resistor R1 is increased and the voltage of the positive terminal of the voltage comparator IC1 becomes smaller than that of the negative terminal thereof, the voltage comparator IC1 outputs a voltage of low level, which causes the PR terminal of the flip-flop circuit IC2 to be low in level. As a result, since the terminal PR and the terminal R of the flip-flop circuit IC2 are low in level, the terminal Q thereof is high in level. The inverter IC3 inverts a high signal output from the terminal Q to a low signal, which is input to the base terminal of the transistor Q2, thereby turning off the transistor Q2. When the transistor Q2 is off, the transistor Q1 is also off, with the result that power supply from the power source 1 to the IC card 4 is stopped. Thus, if the IC card 4 disorders, the power

supply from the power source 1 to the IC card 4 is stopped by the transistor Q1.

FIG. 3 shows true values of the flip-flop circuit IC2 described above.

For example, in the flip-flop circuit IC2, when the terminal R (Reset) is high and the terminal PR (Preset) is low, the terminal Q is high. The inverter IC3 inverts a high signal output from the terminal Q to a low signal, which is input to the base terminal of the transistor Q2, thereby turning off the transistor Q2. When the transistor Q2 is off, the transistor Q1 is also off, with the result that power supply from the power source 1 to the IC card 4 is stopped.

When the power supply to the IC card 4 is stopped, the amount of current flowing through the current detecting resistor R1 is reduced. Accordingly, the voltage at the positive terminal of the voltage compactor IC1 is increased and becomes higher than the voltage at the negative terminal thereof. Therefore, the voltage comparator IC1 outputs a voltage of high level, which is input to the terminal PR of the flip-flop circuit IC2. However, in the flip-flop circuit IC2, even if a signal input to the terminal PR is changed, the state of the terminal Q remains unchanged, unless a low signal is input to the terminal R. Therefore, the power supply of the IC card 4 is kept stopped.

At this time, if the microcomputer 5 goes out of control or malfunctions, the output 1 from the terminal 9 is a low signal. However, since only low pulses of the output 1 from the terminal 9 are input through the differential circuit 8 to the terminal R of the flip-flop circuit IC2, the overcurrent protection circuit is prevented from malfunctioning.

As described above, according to the embodiment of the present invention, the overcurrent protection circuit is prevented from malfunctioning when power is supplied to the IC card (load) and from stopping when the microcomputer goes out of control.

Claims

1. A power supply device for supplying power to an electronic device (4) acting as a load, comprising:

   power source means (1) for providing power to be supplied to the electronic device;
   overcurrent protecting means (2, 3, 5, 6, 7) for stopping power supply to the electronic device, when a current supplied to the electronic device is greater than a predetermined current; and
   stopping means (5, 6, 7) for stopping an operation of the overcurrent protecting means until a load voltage of the electronic device is stabilized, when power is first supplied to the electronic device.

2. The power supply device according to claim 1, wherein the overcurrent protecting means include:

   controlling means (3, 7) for controlling supply and stop of the power provided by the power source means to be supplied to the electronic device; and
   detecting means (2) for detecting the current supplied to the electronic device, and outputting a signal for stopping the supply of the power to the electronic device by means of the controlling means, when a current greater than the predetermined current is detected.

3. The power supply device according to claim 2, wherein the stopping means include first means (5, 6) for stopping a detecting operation of the detecting means (2), until a load voltage of the electronic device is stabilized.

4. The power supply device according to claim 2, wherein the stopping means (3, 5, 6, 7) include second means for controlling the controlling means so that the power is supplied to the electronic device regardless of the signal output from the detecting means (2), until a load voltage of the electronic device is stabilized.

5. An overcurrent protection circuit incorporated in a power supply device for supplying power to an electronic device (4) acting as a load, said overcurrent protection circuit comprising:

   a power source circuit (1) for providing power to be supplied to the electronic device;
   a controlling circuit (3, 7) for controlling supply and stop of the power provided by the power source circuit to be supplied to the electronic device;
   a detecting circuit (2) for detecting the current supplied to the electronic device, and outputting a signal for stopping the supply of the power to the electronic device by means of the controlling circuit, when a current greater than the predetermined current is detected; and
   a stopping circuit (5, 6) for stopping a detecting operation of the detecting circuit until a load voltage of the electronic device is stabilized, when power is first supplied to the electronic device.

6. An overcurrent protection circuit characterized by comprising:

   power supply means (1) for supplying power;
   switch means (3) for switching power supply and stop of power supply to an IC card (4) connected to the power supply means;
   current detecting means (2) for detecting

whether a current exceeds a predetermined detection level, when power is supplied from the power supply means to the IC card;

stop means (2) for stopping the power supply by switching the switch means, when the current detection means detect that the current exceeds the predetermined detection level;

a microcomputer (5) for outputting an instruction signal for switching the switch means;

first control means (6) for controlling the predetermined detection level of the current detection means to be a lower detection level until a load voltage of the IC card is stabilized, when power is supplied from the power supply means to the IC card by switching the switch means in accordance with an instruction signal output from the microcomputer; and

second control means (6) for performing control of preventing a malfunction due to a false signal output from the microcomputer, when power supply from the power supply means to the IC card is stopped by switching the switch means in accordance with an instruction signal output from the microcomputer.

7. The overcurrent protection circuit according to claim 6, characterized in that the first control means (6) lower the predetermined detection level of the current detection means to be a lower detection level, when power is supplied from the power supply means to the IC card by switching the switch means in accordance with an instruction signal output from the microcomputer, and it raise the lower detection level of the current detection means to be the predetermined detection level in accordance with an instruction signal output from the microcomputer, when the load voltage of the IC card supplied with the power is stabilized.

8. The overcurrent protection circuit according to claim 6, characterized in that the second control means (6) prevent a malfunction due to a false signal output from the microcomputer by means of a differential circuit, when power supply from the power supply means to the IC card is stopped in accordance with an instruction signal output from the microcomputer.

9. A method for controlling an overcurrent protection circuit (2, 5, 6, 7) incorporated in a power supply device for supplying power to an electronic device (4) acting as a load, wherein a current supplied to the electronic device is detected by a detecting circuit (2) and power supply to the electronic device is stopped, when the detected current is greater than a predetermined current, said method comprising the steps of:

stopping an operation of the detecting circuit until a load voltage of the electronic device is stabilized, when power is first supplied to the electronic device; and

releasing the stop of the operation of the detecting circuit after the load voltage of the electronic device is stabilized.

10. A method for controlling an overcurrent protection circuit including: switch means (3) for switching power supply and stop of power supply to an IC card (4) connected to power supply means (1) for supplying power; a microcomputer (5) for outputting an instruction signal for switching the switch means; and current detecting means (2) for detecting whether a current exceeds a predetermined detection level, when power is supplied from the power supply means to the IC card, said method comprising the steps of:

lowering the predetermined detection level of the current detection means to be a lower detection level, when power is supplied from the power supply means to the IC card by switching the switch means in accordance with an instruction signal output from the microcomputer; and

raising the lower detection level of the current detection means to be the predetermined detection level in accordance with an instruction signal output from the microcomputer, when the load voltage of the IC card supplied with the power is stabilized.

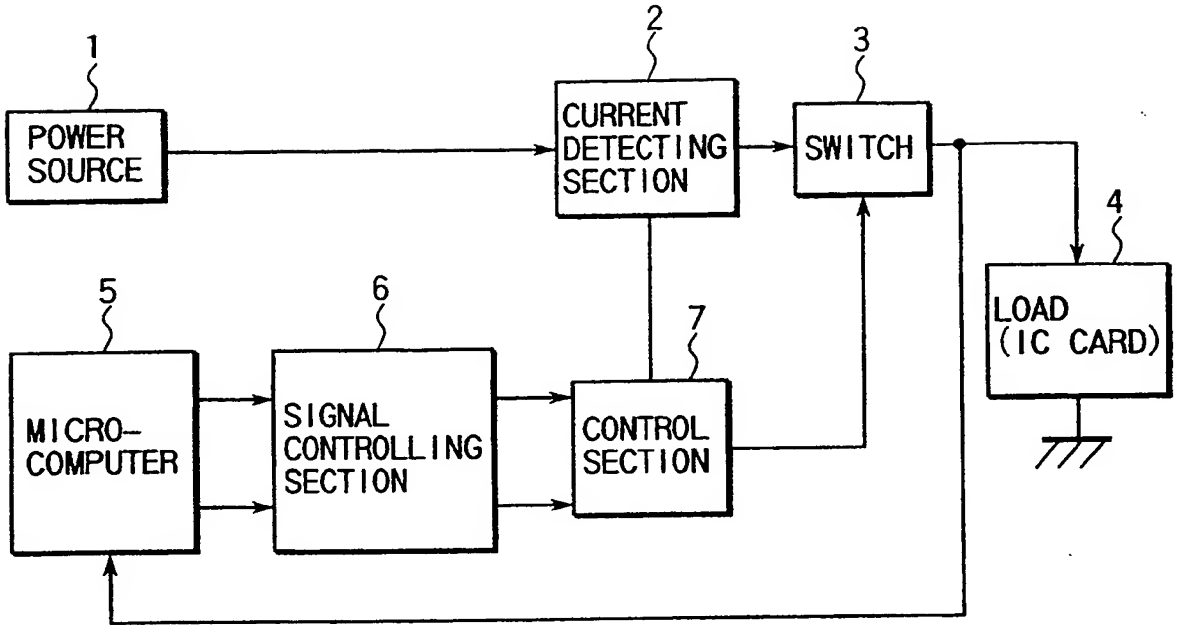

FIG. 1

INPUT		OUTPUT
TERMINAL R (RESET)	TERMINAL PR (PRESET)	TERMINAL Q
Lo	Hi	Lo
Hi	Lo	Hi
Lo	Lo	Hi

FIG. 3

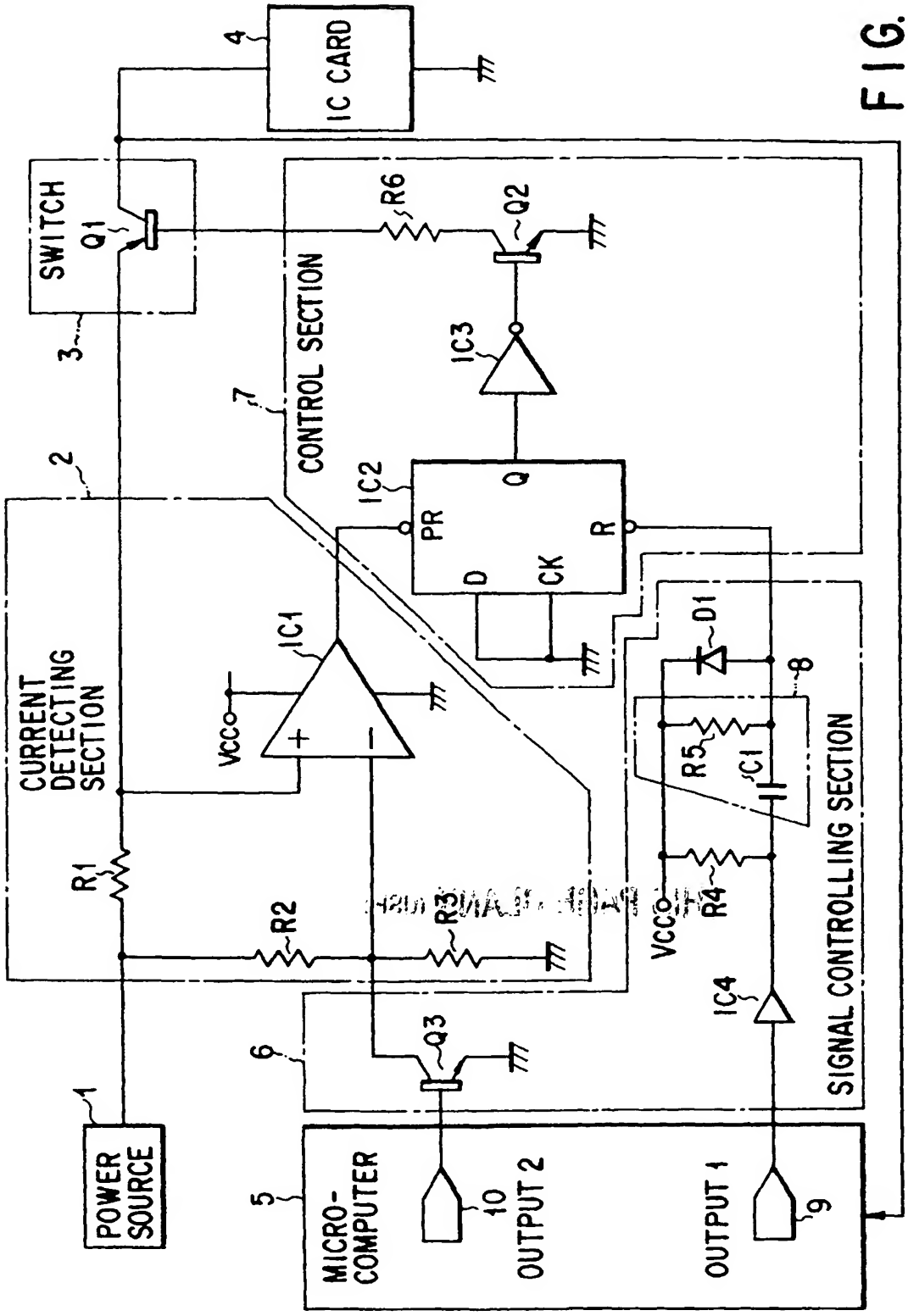

FIG. 2

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 862 261 A3

(12) EUROPEAN PATENT APPLICATION

(88) Date of publication A3:
20.10.1999 Bulletin 1999/42

(43) Date of publication A2:
02.09.1998 Bulletin 1998/36

(21) Application number: **98102933.3**

(22) Date of filing: **19.02.1998**

(51) Int. Cl.[6]: **H02H 3/087**

(84) Designated Contracting States:
AT BE CH DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **27.02.1997 JP 4382297**

(71) Applicant:
KABUSHIKI KAISHA TOSHIBA
Kawasaki-shi (JP)

(72) Inventors:
- **Noguchi, Minoru**
  1-1 Shibaura 1-chome Minato-ku Tokyo 105 (JP)
- **Katsumi, Takahiro**
  1-1 Shibaura 1-chome Minato-ku Tokyo 105 (JP)
- **Suzuki, Toshiyuki**
  1-1 Shibaura 1-chome Minato-ku Tokyo 105 (JP)
- **Kawagishi, Toshiyuki**
  1-1 Shibaura 1-chome Minato-ku Tokyo 105 (JP)

(74) Representative:
Blumbach, Kramer & Partner GbR
Radeckestrasse 43
81245 München (DE)

(54) Overcurrent protection circuit and method

(57) In an overcurrent protection circuit, when a control section (7) turns on a switch (3) in response to a signal from a microcomputer (5) so that power is supplied from a power source (1) to an IC card (4), a signal controlling section (6) prevents the overcurrent protection circuit from functioning even if a current greater than a predetermined level is detected by a current detecting section (2), until a voltage of the IC card is stabilized. When the control section (7) turns off the switch (3) in response to a signal from the microcomputer (5), power supply from the power source (1) to the IC card (4) is stopped, thereby preventing a malfunction of the overcurrent protection circuit, even if the microcomputer (5) goes out of control or malfunctions.

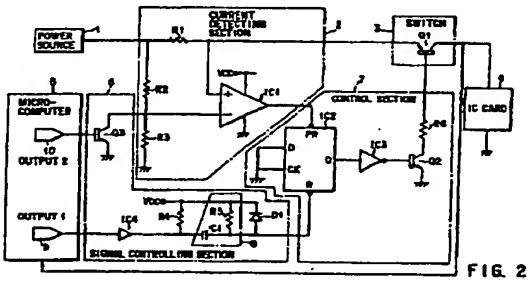

FIG. 2

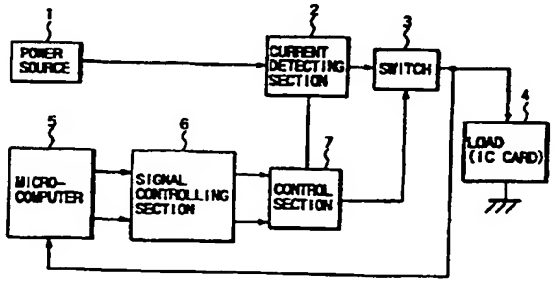

FIG. 1

EP 0 862 261 A3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 98 10 2933

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	DE 38 42 921 A (BOSCH GMBH ROBERT) 28 June 1990 (1990-06-28) * abstract; figure 1 * * column 1, line 54 - column 2, line 2 * * column 3, line 19 - line 23 * ---	1-5,9,10	H02H3/087
X	US 4 819 117 A (BRENNAN DANIEL G ET AL) 4 April 1989 (1989-04-04) * abstract; figure 1 * * column 2, line 37 - column 3, line 54 * * column 5, line 26 - line 56 * ---	1-5,9,10	
X	DE 43 16 185 A (FAHRZEUGKLIMAREGELUNG GMBH) 17 November 1994 (1994-11-17) * abstract; figure 1 * * column 2, line 14 - line 23 * * column 4, line 55 - column 5, line 6; claim 10 * -----	1-5,10	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			H02H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	31 August 1999	Thisse, S

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 98 10 2933

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

31-08-1999

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 3842921 A	28-06-1990	NONE	
US 4819117 A	04-04-1989	NONE	
DE 4316185 A	17-11-1994	FR 2705508 A GB 2278025 A,B	25-11-1994 16-11-1994

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82